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LABRADOR – ISLAND TRANSMISSION LINK, REVIEW OF THE MARINE ENVIRONMENT AND EFFECTS MODELLING COMPONENT STUDY

Context

Nalcor Energy is proposing to develop the Labrador – Island Transmission Link (the Project), a high voltage direct current (HVdc) transmission system extending from Central Labrador to the Island of Newfoundland's Avalon Peninsula which will include the installation of submarine cables across the Strait of Belle Isle (SOBI). In preparation for, and support of the Project, Nalcor Energy has submitted to Marine Habitat Protection Section of Fisheries and Oceans Canada in Newfoundland and Labrador a series of environmental assessment reports. In November 2011, the report entitled "Marine Environment and Effects Modelling Component Study" was submitted. The submission is comprised of three study reports: (1) Strait of Belle Isle: Oceanographic Environment and Sediment Modelling (June 2011) – A study to model the likely characteristics of sedimentation that may occur as a result of marine construction activities associated with the Strait of Belle Isle submarine cable crossing, (2) Sound Modelling: Proposed Strait of Belle Isle Cable Installation Activities (June 2011) – A study to estimate and describe potential sound level resulting from the proposed construction activities associated with underwater cable installation in the Strait of Belle Isle, and (3) Environmental Modelling: Proposed Shore Electrodes (August 2011) – A study to estimate the emissions associated with monopolar and bipolar operations of the electrodes for two HVdc system voltages, 320 kV and 400 kV. The report can be accessed at the following link, http://www.env.gov.nl.ca/env/env_assessment/projects/Y2010/1407/index.html.

The environmental modeling presented in this Marine Environment and Effects Modelling Component Study will be incorporated and used in the Project's eventual Environmental Impact Statement (EIS), which will provide a summary description of the existing environment and an environmental effects assessment for the Project. While these reports will feed into the assessment of potential environmental effects, they do not in themselves constitute an analysis of what these may be.

The Marine Habitat Protection Section (NL Region) sent a request to Science Branch on November 7, 2011 and a response was requested by December 8, 2011. A Science Special Response Process (SSRP) was used due to the short deadline for advice.

A number of questions and issues about the formulation of the models and the assumptions used to parameterize them were raised with respect to the Oceanographic Environment and Sediment Modelling report. Several problems remain with the Sound Modelling report.

This Science Response report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, Regional Science Special Response Process (SSRP) of November 7 – December 8th, 2011 on the Science review of the Environmental Assessment report on Marine Environment and Effects Modelling Component Study.

Analysis and Responses

Strait of Belle Isle: Oceanographic Environment and Sediment Modelling (June 2011)

Following the review of this portion of the document, a number of questions and issues about the formulation of the models and the assumptions used to parameterize them exist. The models underestimate the current speeds in the Straits and the total sediment that may be suspended by rock laying activities. Therefore the concentrations of suspended sediment and the duration of sediment suspension events will be underestimated.

This study presents the results of a modelling exercise linking a 2 dimensional hydrodynamic model (HYDRO2D) of the currents in the Strait of Belle Isle in the vicinity of the likely corridor for the proposed Labrador – Island transmission link with a particle tracking model (BBLT) for sediment suspended by the process of laying rock to protect the cable.

The BBLT models sediments suspended during the laying of the protective rock cover over the transmission cables in the Straits of Belle Isle. The amount of sediment in suspension is assumed to come solely from the resuspension of silt and sand from the bottom as it is disturbed by the rock dump. This estimate assumes that there are no fines associated with the rock that will be used to cover the cables. This is unlikely, while the amount of fines may be small relative to the total volume of rock, it will be winnowed out of the material as it falls to the sea floor and will remain in suspension in the water column. This component of suspended sediment should also be modelled. While BBLT can capture this sediment as it nears the bottom, it may not be the appropriate model to use for the rest of the water column affected.

There are many assumed parameters associated with the BBLT rock placement component. It would be plausible to simulate different combinations and provide a sensitivity analysis of the modelled results.

The hydrodynamic model (HYDRO2D) simulates current fields in two dimensions for currents driven by tidal or atmospheric forcings. The report includes as assessment of the current under cross-strait sea surface height gradient, however, the information is not used to force the sediment model. There are a number of problems with the model formulation, parameterization and testing.

- It does not consider maximum current speeds in the Straits as high as 7 knots (3.9 m/s) reported by Ingram (1982, as cited by JASCO Applied Sciences, 2011)
- The approach used ignores general circulation which on average represents roughly 50% of current in all seasons at all depths (AMEC, 2010). Average and maximum current speeds generated by the HYDRO2D model are therefore 50% lower than those calculated by AMEC (2010) using historical records for the region.
- The current meter records used for model testing are available only for the period between mid July to October. Thus inter season variability is not considered here. While maximum current speeds are greatest in the summer and fall, average current speeds are highest in the winter (AMEC 2010). Unless the cable will be laid and covered only during the summer, the modelling exercise should be extended to other seasons.

- The vertical shear of the horizontal current is a very important dispersal mechanism in the BBLT model. Therefore, 3-D currents should be used. The hydrodynamic model used is a 2 dimensional model generating depth-averaged currents. The output is linked to near bottom currents and the BBLT model by assuming a logarithmic decrease in current speed with depth (p 48). There is no detail about the logarithmic function. There is no justification or quantification of uncertainties provided for this assumption, and it does not match the observed or inferred near bottom current speeds for the region (AMEC, 2010). Toulany et al. (1987 as cited in AMEC, 2010) found that the currents related to atmospheric forcings were decreased by 50% near bottom. However, these contribute only about 20% of the total current speed. Currents relating to tidal and general circulation are between 80-100% of surface levels. AMEC (2010) estimated near bottom current speeds from existing information for the region and found that mean near bottom current speeds ranged from 0.8 m/s in summer to 1.4 m/s in winter with 30 – 60% higher mean speeds expected at peak tides. Maximum near bottom current speeds were estimated to range from 2.8 m/s in summer to 3.3 m/s in winter and spring.
- BBLT was run with the input from the tidal currents only. The simulation does not include boundary inflow, or atmospheric forcing, or density effect. The report states that tidal currents are dominant. However, based on the description on page 25 (earlier literature information and recent data), non-tidal currents are significant. In fact they may be dominant from time to time as tidal currents fluctuate. The report should show typical flows at synoptic time scales and their impacts should be quantitatively assessed. The recommendation is to run a three-dimensional baroclinic circulation model forced by tide, meteorological and boundary forcing. The model should be validated. The model currents are then used to force the BBLT model.

As a result of these problems, the near bottom currents generated by HYDRO2D and coupled to BBLT are too low. The output of this modelling exercise cannot be used to determine suspended sediment concentrations, duration of suspended sediment events or the ultimate dispersion of the re-settled sediments. They are therefore not suitable for use to assess the potential environmental effects of sediment suspension events that will accompany the laying of the rock cover over the transmission cables.

Sound Modelling: Proposed Strait of Belle Isle Cable Installation Activities (June 2011)

As part of the Labrador – Island Transmission Link, there will be installation of submarine cables across the Strait of Belle Isle. The EA includes descriptions and magnitude models for potential sound levels resulting from the proposed construction: (1) horizontal directional drilling, (2) transit of cable-laying vessel, (3) operations of cable-laying vessel in dynamic positioning (DP) mode, (4) transit of rock-placement vessel, and (5) operations of rock-placement vessel in DP mode. According to the modelled received sound levels, the proposed operations will produce underwater sound energy at levels appreciably higher than ambient noise levels at distances of kilometres for some frequencies and locations.

When M-weighting is applied to the modelled received sound levels, there are reductions in received levels for marine mammal listeners at most ranges. However, M-weighting has little effect on maximum range radii during rock-placement and cable laying operation while the vessels are in DP mode. Broad-band noise levels as high as 50 dB above ambient are expected to be detected as far as 14 km from the source.

Specific Issues:

M-weighting has been promoted as a conservative function to estimate hearing sensitivities in cetaceans (Southall et al., 2007), as it will tend to overestimate perceived levels and thus suggests that more sound is "detected" than C- or A-weighting based on equal-loudness contours. However, this modeling approach most likely does not de-emphasize the auditory frequency response adequately in the non-optimal hearing bands. As a result, its appropriateness for assessing detection levels or potential behavioural responses to the continuous background noise that concerns us here has been recently questioned (see McQuinn et al. 2011; Finneran and Schlundt 2011).

Vessel transit and operations sound characteristics were modelled at only four locations along the proposed cable-crossing corridor. Given the apparent long-range underwater signal propagation, it would have been preferable if more than one site in the deeper waters of the mid-Strait had been assessed. In addition, while the total sound energy exposure from overlapping sound sources (such as drilling plus rock dumping DP work plus cable laying DP work) may not be much higher than each of the sources alone, their effective noise footprint could ensonify waters across the entire Strait. Potential effects on marine mammal use of the Strait, and on their migration patterns and feeding behaviour will need to be evaluated in that perspective (see paragraph below).

Ambient noise was monitored at two sites close to shore where wave action would potentially produce greater values than mid-Strait (Figure 1.1). The nearshore sites were also up on shallow banks away from the higher-slope drop-offs into the Strait. This might limit sound propagation from elsewhere to the receivers relative to deeper water sites. The question remains why only two sites in the mid Strait were monitored. It is desirable to see a summary of the ambient noise measures in terms of location, variation, seasonality, frequency, etc. During quiet periods, NALCOR's operations might have a much greater effect on marine mammals and leatherbacks than it would during noisy or ice-covered periods.

There is also a question with respect to the rationale for using DP levels of 25% and not 100%, for estimating source levels for vessel DP mode operations. "The dive support vessel DSV Fu Lai was recorded by JASCO while operating in DP mode, with DP levels of 25%, i.e., at approximately 3000 HP (MacGillivray, 2006). The calculated source levels from these recordings were used to estimate the source levels for vessels in DP mode during the proposed construction activities for the SOBI submarine cables."

It is noted that the underwater sound level rises again as the frequency approaches 100 Hz (Figure 2.1). Information is lacking on the sound levels for drilling at closer ranges and for higher frequencies such as up to 500 Hz, which could be detected by marine mammals such as toothed whales and pinnipeds.

The assumed DP third-octave band source levels of 185.3 dB re 1 µPa @ 1 m up to 10 kHz are very loud, and could induce temporary threshold shift (TTS) in some marine mammal species that remain near the operations (recent studies in Europe suggest that harbour seals and young grey seals seem attracted to the sounds of vessel thrusters and either remain nearby for extended periods, or have been killed when sucked into the thruster system).
The modelled received levels, while seemingly unlikely to induce hearing sensitivity changes except at short distances from the source, propagate at levels thought high enough to cause

behavioural changes (in some cases to several kilometres). For the DP cable operations in the deeper parts of the Strait, such sound levels are above ambient across almost the entire Strait (e.g., Tables 3.15, 3.16, and 3.22; Figure 3.24), and such sound output would last for extended periods of time.

Cetaceans have shown responses to underwater anthropogenic sounds at levels far less than 50 dB above ambient. Therefore, the rationale for selecting 50 dB above ambient level as the minimal level to display on the figures (P. 50) should be questioned. It would be useful to see (no doubt large) received sound distances for levels lower than 50 dB above ambient. Some of the lower root mean square (RMS) values, which could be perceived above ambient levels, are modelled to extend to more than 10 km (Tables 3.1 and 3.2 for example).

Multiple sound sources would likely be more disturbing to migrating marine mammals than a single source in a fixed location. However, cumulative impacts of having the NALCOR operations in addition to the current passage of many large freighters, ferries, and fishing vessels are not considered.

Regardless of the results from the modelling, it is recommended that the proponent measure the actual sound levels to ascertain the accuracy of the modelled sound values, since it is known in other locales that modelled and actual sound propagation behaviour differed (e.g., McQuinn et al. 2011). This would be particularly important given the high sound speeds and low sound attenuation values featured by the underlying limestone in the shallow and deeper seabed areas, that were modelled in the project area (Tables 2.4, 2.5, and 2.6). For example, the received levels are higher at greater distances for the undersea drilling operations than for vessel transits, which suggest that seabed sound propagation is very important in this area (e.g., Table 3.1 versus Table 3.5).

For noise exposure criteria, it is suggested the authors cite and employ Southall et al. (2007) in place of the dated Gentry et al. 2004.

It is understood that the current study was not intended to enter the area of potential biological effects. It is important that literature related to potential effects on various aquatic organisms-and the conclusions drawn- be fully covered in the EIS.

Environmental Modelling: Proposed Shore Electrodes (August 2011)

This study presents the results of a modelling exercise to determine the magnitude and extent of potential effects of the shore electrodes proposed for the transmission line. It examined the potential for electrical, magnetic, chemical and physical (heat) effects.

On page 61 the report states that the calculations for chlorine production were based on standard temperature and pressure (STP). This is 20° C and 1 atm. Since the maximum sea surface temperatures rarely if ever achieves 20° C (see figure 2.1-10 in the Labrador – Island Transmission Link Environmental Assessment - Marine Environment and Effects Modelling Component Study) it would be more appropriate to use seasonally adjusted temperatures that are closer to ambient.

It is understood that the current study was not intended to enter the area of potential biological effects. It is important that literature related to potential effects on various aquatic organisms-and

the conclusions drawn- be fully covered in the EIS. Given that estimates for production of chlorine are rather high for conditions of "maximum continuous current", literature dealing with the acute and sublethal effects of chlorine on marine organisms should also be addressed in the EIS.

Conclusions

The three study reports included in the submission for the Marine Environment and Effects Modelling Component Study were reviewed. As a result of that review the following points were raised.

A problem remains with the Oceanographic Environment and Sediment Modelling report and there are a number of questions and issues about the formulation of the models and the assumptions used to parameterize them. The models underestimate the current speeds in the Straits and the total sediment that may be suspended by rock laying activities. Therefore the concentrations of suspended sediment and the duration of sediment suspension events will be underestimated. As a result this study is not suitable to use as input for determining the potential environmental effects of the sediments that are suspended during the laying of rock to cover the cross straight transmission cables.

Problems remain with the Sound Modelling report. Vessel transit and operations sound characteristics were modelled at only four locations along the proposed cable-crossing corridor; given apparent long-range underwater signal propagation, it would be better if more than one site in the deeper waters of the mid-Strait had been assessed. The sound modelling approach that estimates only sounds at magnitudes of 50 dB above ambient overlooks existing literature that describes how some sounds for some marine mammals can elicit behavioural responses and displacement at intensities just above ambient noise levels. In addition, for the EIS it will be important that the proponent consider the potential cumulative impacts of multiple sounds sources and/or sound sources which are arrayed across the trait in a way that might create an acoustic “barrier” to migrating marine mammals. No matter what the results from the modelling, it is recommended that the proponent measure the actual sound levels to ascertain the accuracy of the modelled sound values, since we know in some other locales that modelled and actual sound propagation behaviour differed significantly.

The calculations for chlorine production (modelling exercise for the proposed shore electrodes) were based on standard temperature and pressure (STP), however, it would be more appropriate to use seasonally adjusted temperatures that are closer to ambient.

It is understood that the current study was not intended to enter the area of potential biological effects. It is important that literature related to potential effects on various aquatic organisms-and the conclusions drawn- be fully covered in the EIS.

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Sources of information

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